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DRAWINGS ATTACHED

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(54) IMPROVEMENTS IN OR RELATING TO VEHICLE WHEELS

(71) We, THRING ADVANCED DEVELOPMENTS LTD., a British Company of 309 Western Bank, Sheffield 10, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to wheels for vehicles.

There is a need for a wheel which will enable vehicles particularly invalid carriages or wheelchairs to climb stairs, negotiate obstacles and travel smoothly over level surfaces. A general object of this invention is to provide such a wheel.

According to the present invention there is provided a rimless vehicle wheel composed of a hub and a plurality of separate elongate arms extending radially outwards from said hub for supporting said wheel on the ground, each arm being formed with a radially outermost part resiliently biased outwardly from a radially-innermost part and radially movable in relation thereto. The means providing the resilient biasing force on each arm are preferably so arranged that the wheel can revolve over a level surface in the same characteristically smooth manner as a conventional rimmed wheel. However, a wheel made in accordance with the invention can be used in a vehicle to enable the vehicle to climb stairs, negotiate obstacles or generally travel smoothly over rough ground as well as travel normally over smooth level ground. In negotiating an obstacle or climbing a stair, an arm of a wheel made in accordance with this invention will engage the obstacle or stair and cause the axis of the wheel to rotate about the point of contact of the arm with the obstacle. To enable the stair climbing function to be performed the wheel preferably has at least eight arms but not more than twenty arms. The radially outermost end of each arm preferably carries a wear-resistant frictional pad or the like.

[*Price 25p*]

In a preferred construction the parts of the arms are of rectangular cross-section.

In one construction the outermost part of each arm extends partially within the innermost part of the arm in telescopic manner. In another construction the innermost part of each arm extends partially within the outermost part of the arm in telescopic manner.

At least one compression spring may be used to resiliently bias the outermost part of each arm outwardly from the innermost part.

The preloading of the spring force of each of the compression springs is preferably adjustable.

The invention may be understood more readily, and various other features of the invention may become more apparent, from consideration of the following description.

Embodiments of the present invention will now be described, by way of examples only, with reference to the accompanying drawings in which:—

Figure 1 is a diagrammatic side view of a wheel made in accordance with the invention;

Figure 2 is a diagrammatic side view of part of a wheel made in accordance with this invention depicting the telescoping function of the arms;

Figure 3 is a diagrammatic side view of part of a wheel made in accordance with the invention also depicting the telescoping function of the arms;

Figure 4 is a diagrammatic plan view of a vehicle employing wheels made in accordance with the invention;

Figure 5 is an enlarged part sectional perspective view of one of the arms of a wheel made in accordance with the invention; and

Figure 6 is an enlarged section side view of one of the arms of a further wheel made in accordance with the invention.

As shown in Figure 1, a wheel is composed of a central hub 10, which can be secured to an axle (not shown) in a conventional manner, and a number, in this case twelve, of arms 11 extending radially out-

wardly of the hub 10. Each arm 11 is telescopic with two parts 12, 13. A radially outermost part 12 of each arm 11 is resiliently biased outwardly of a radially innermost part 13 by means of a compression spring (not shown in Figure 1), for example, and some form of stop means prevents the parts 12, 13 from becoming detached from one another under the action of the biasing force. At least the radially outermost end of the part 12 has a detachable wear-resistant friction pad 14, for example made of a relatively hard rubber. In a practical construction, the hub would receive an axle or drive shaft and preferably has some form of bearing therefor. The arms 11 can be rigidly or flexibly attached to the hub 10. The flexible coupling between the hub 10 and the arms 11 would be advantageous in cushioning shock when the wheel is used in a vehicle climbing stairs, for example, as mentioned again hereinafter. Bracing members 16 linking the innermost parts 13 of the arms may be used to strengthen the wheel. The radial distance between the radially outer end of one of the arms 11 with part 12 in its radially outermost position and the bracing member 16 must be at least equal to, and is preferably greater than one-half the maximum distance, in a circumferential direction, between two adjacent arms 11.

During normal rotation of the wheel along a level ground surface each arm 11 successively supports the weight or a proportion of the weight of the associated axle and vehicle and the outer part 12 partially retracts within the inner part 13. As can be appreciated from Figure 2 the biasing force which resists this retraction is such that when only one arm 21 is contacting the ground surface 'L' the amount of retraction '*r*' of its outer part 12 is less than the difference between the normal radial length of the arm 11 '*l*' and the perpendicular distance between a chord '*c*' joining the arc '*a*' between the ends of the two arms 22, 23 adjacent the arm 21 in question and the axis K of the wheel. Figure 3 illustrates the condition where two of the arms 11 are in contact with the level ground surface 'L' and each subject to substantially equal loading. In this case the retraction of the parts 12 relative to the parts 13 is substantially one half that when one of the arms 11 only contacts the surface 'L'. Thus, no matter how many arms are contacting the surface 'L' the vertical position of the axis of the hub is substantially unchanged. Hence with a wheel made in accordance with the invention, the movement of the wheel on the level surface 'L' is similar to that of a conventional rimmed wheel since the axis of the hub 10 will only move to a limited extent between two vertical positions. The movement of the axis will be sufficiently small as to be absorbed by damping or merely by the springing of the seat of the vehicle employing the wheels.

As well as this essentially smooth travel over a level surface, the construction of the wheel is such that when the wheel encounters an obstacle, such as a step shown in dotted outline in Figure 1, and designated S, the axis of the wheel is rotated upwardly about the point of contact of the arm with the obstacle to enable the vehicle to negotiate the obstacle. Needless to say the arms 11 must be sufficiently strong so that each arm 11 can take the whole weight borne by the associated axle when the arm 11 encounters an obstacle. It has been found that the overall radius of the wheel should be slightly greater than the height of the step S for best results, and where a staircase is to be climbed the arms 11 would preferably each engage one stair in succession.

It is preferable that the wheel have at least eight arms so that the amount of retraction 'r' need not be too great. It is also preferable that the wheel have no more than twenty arms otherwise the spacing between the arms 11 will be too narrow to enable stairs to be climbed. It is desirable to make the width of each arm 11 as small as possible so as to make the spacing between the arms 11 as great as possible but the width is also governed by the strength requirement.

A vehicle, such as a wheelchair, may be constructed utilising wheels constructed in accordance with the invention as depicted in Figure 4. In Figure 4, the vehicle chassis is represented diagrammatically and denoted by the reference numeral 60. The chassis 60 bears four axles or shafts 61 each carrying a wheel 62 made in accordance with the invention such as for example as shown in Figure 1. A separate drive means 63 is provided for each wheel, and the drive means 63 should provide sufficient torque to enable the arms to lift the vehicle over an obstacle or up a staircase.

It is preferable for the movement of the arms of the back wheels to be about 15° or so out of phase with the movement of the arms of the front wheels. With such an arrangement the vehicle enables its user to climb stairs, negotiate obstacles or travel smoothly over rough ground according to choice and in addition to normal travel over a level surface.

Figure 5 illustrates in more detail one constructional form for the arms 11. The radially innermost part 13 is in the form of a hollow steel member of rectangular cross-section and such a shape has been found to be advantageous since it enables better engagement upon steps and it also resists bending. The radially outermost part 12 is also in the form of a hollow steel member of rectangular cross-section which slidably engages over the radially outer end of the

part 13. The surfaces of the parts 12, 13 which thus slidably engage one another are preferably coated with a suitable synthetic plastics material. Two compression springs 30 are disposed between an end wall 32 of the part 12 and a guide plate 33. The springs 30 are in engagement with the wall 32 and the plate 33 and are compressed therebetween.

A threaded member 36 is received within each spring 30, and is threadably engaged in a bore within a further plate 31 disposed beneath the plate 33. At the radially outer end, each member 36 extends through an aperture in the end wall 32 and is threadably engaged with a stop means in the form of a nut 34. The nuts 34 can thus be tightened or loosened to vary the degree of compression of the springs 30. The guide plate 33 is provided with radially outwardly projecting upstanding flanges 35 having threaded bores 39 which receive screws 40 passed through apertures in the facing side walls 38 of the part 13 and flush with the outer faces of these walls 38. When loaded radially the part 12 will extend over the screws 40.

The detachable wear-resistant pad 14 mentioned earlier, is placed onto the radially outer end of the part 12 to cover the nuts 34. The assembly composed of the part 12, the members 36, the springs 30 and the plates 33, 31 can be removed from the part 13 by detaching the screws 40. This enables the springs 30 to be pre-set exteriorly to the required compression and a batch of assemblies can be adjusted together. The arrangement also minimises the amount of dirt reaching the interior of the arm 11.

A further example of a construction for the arms 11 is shown in Figure 6. The radially innermost part 13 and the radially outermost part 12 are again hollow steel members of rectangular cross-section but the outermost part 12 in this case slides within the part 13. A single compression spring 30 is disposed within the part 13 to engage on an end wall 47 of the part 12 and bias the part 12 radially outwardly. The radially outer end of the part 12 is again provided with the detachable wear-resistant pad 14. The side walls 41, 42 of the part 13 are provided with elongated slots 43 which slidably accommodate pins 44 affixed to the corresponding side walls 45, 46 of the member 12. The pins 44 and slots 43 form stop means preventing parts 13 and 14 becoming detached under the action of spring 30. Some means for adjusting the compression of the spring 30 may also be provided.

WHAT WE CLAIM IS:—

1. A rimless vehicle wheel composed of a hub and a plurality of separate elongate arms extending radially outwards from said hub for supporting said wheel on the ground, each arm being formed with a radially outermost part resiliently biased outwardly from a radially-innermost part and radially movable in relation thereto.

2. A wheel according to claim 1, wherein there are at least eight and not more than twenty arms.

3. A wheel according to claim 1 or 2, wherein the innermost part of each arm extends partially within the outermost part of the arm in telescopic manner.

4. A wheel according to claim 1 or 2, wherein the outermost part of each arm extends partially within the innermost part of the arm in telescopic manner.

5. A wheel according to any one of claims 1 to 4, wherein each arm has stop means for preventing the parts thereof from becoming detached from one another under the action of the aforesaid resilient biasing force.

6. A wheel according to any one of claims 1 to 5, wherein the outermost part of each arm is provided with a wear-resistant friction pad.

7. A wheel according to any one of claims 1 to 6, wherein at least one compression spring is used to resiliently bias the outermost part of each arm radially outwardly from the innermost part.

8. A wheel according to claim 7, wherein the spring force of each of the compression springs is adjustable.

9. A wheel according to any one of claims 1 to 8, wherein each arm is of rectangular cross-section.

10. A wheel acording to any one of claims 1 to 9, wherein the parts of each arm can be disassembled from one another.

11. A wheel according to any one of claims 1 to 10, and further comprising bracing members linking the radially innermost parts of the arms, the bracing members being disposed radially inwardly from the radially outer ends of the arms by a distance equal to or greater than one-half the distance in a circumferential direction, separating the radially outer ends of two adjacent arms.

12. A wheel according to claim 1, substantially as described with reference to, and as illustrated in Figure 1 of the accompanying drawings, or Figure 1 of the accompanying drawings in conjunction with Figures 2 or 3 of the accompanying drawings.

13. A wheel according to claim 1, having arms substantially as described with reference to and as illustrated in Figure 5 or Figure 6 of the accompanying drawings.

14. A vehicle capable of climbing a staircase and having a plurality of rimless wheels each wheel being made in accordance with any one of claims 1 to 13, and separate drive means for each wheel.

15. A vehicle according to claim 14, wherein there are a pair of such wheels at the front and at the rear of the vehicle, the arms of the front and rear wheels being arranged to move out of phase with one another.

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1296495 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

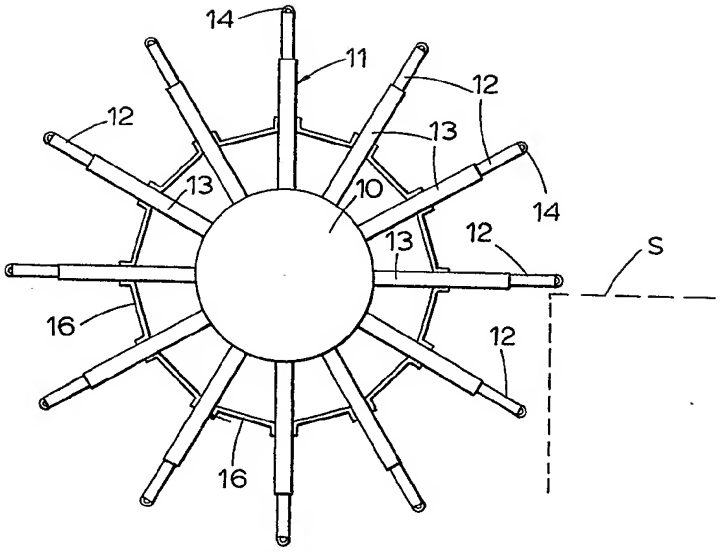

FIG. 1.

FIG. 2.

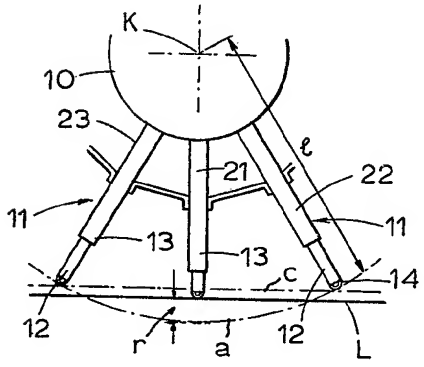

FIG. 3.

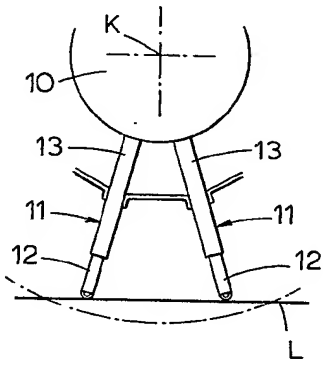

FIG. 4.

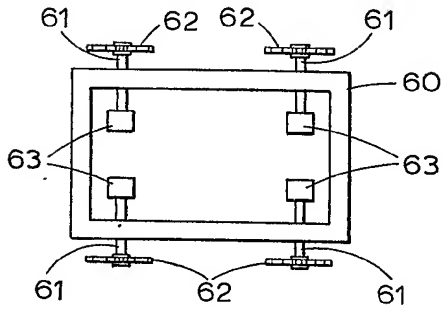

FIG. 5.

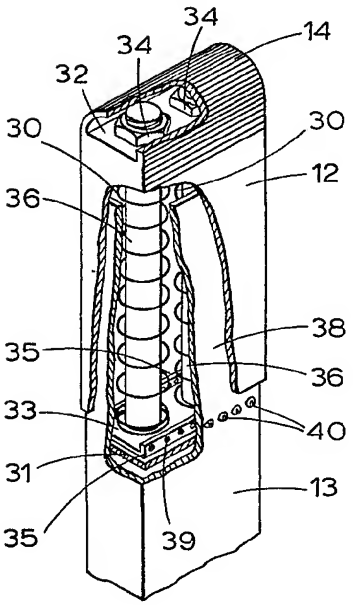

FIG. 6.